

## 1 INTRODUCTION

Over the last five decades, the U.S. Department of Energy (DOE) has enriched large quantities of uranium for nuclear applications by means of gaseous diffusion. This enrichment has taken place at three DOE sites located at Paducah, Kentucky; Portsmouth, Ohio; and the East Tennessee Technology Park (ETTP, formerly known as the K-25 site) in Oak Ridge, Tennessee (Figure 1-1). “Depleted” uranium hexafluoride (commonly referred to as DUF<sub>6</sub>) is a product of this process. It is being stored at the three sites. The total DUF<sub>6</sub> inventory at the three sites weighs approximately 700,000 metric tons (t) (770,000 short tons [tons])<sup>1</sup> and is stored in about 60,000 steel cylinders.

This document is a site-specific environmental impact statement (EIS) for construction and operation of a proposed DUF<sub>6</sub> conversion facility at the Paducah site. The proposed facility would convert the DUF<sub>6</sub> stored at Paducah to a more stable chemical form suitable for use or disposal. A separate EIS (DOE 2003a) evaluates potential impacts for a proposed conversion facility to be constructed at the Portsmouth site. The EISs have been prepared in accordance with the National Environmental Policy Act of 1969 (NEPA) (*United States Code*, Title 42, Section 4321 et seq. [42 USC 4321 et seq.]), Council on Environmental Quality (CEQ) NEPA regulations (*Code of Federal Regulations*, Title 40, Parts 1500–1508 [40 CFR Parts 1500–1508]), and DOE’s NEPA implementing procedures (10 CFR Part 1021).

This EIS addresses the potential environmental impacts at the Paducah site from the construction, operation, maintenance, and decontamination and decommissioning (D&D) of the proposed conversion facility; from the transportation of depleted uranium conversion products to a disposal facility; and from the transportation, sale, use, or disposal of the fluoride-containing conversion products (hydrogen fluoride [HF] or calcium fluoride [CaF<sub>2</sub>]). Three alternative locations within the Paducah site are evaluated for the conversion facility. Although not part of the proposed action, an option of

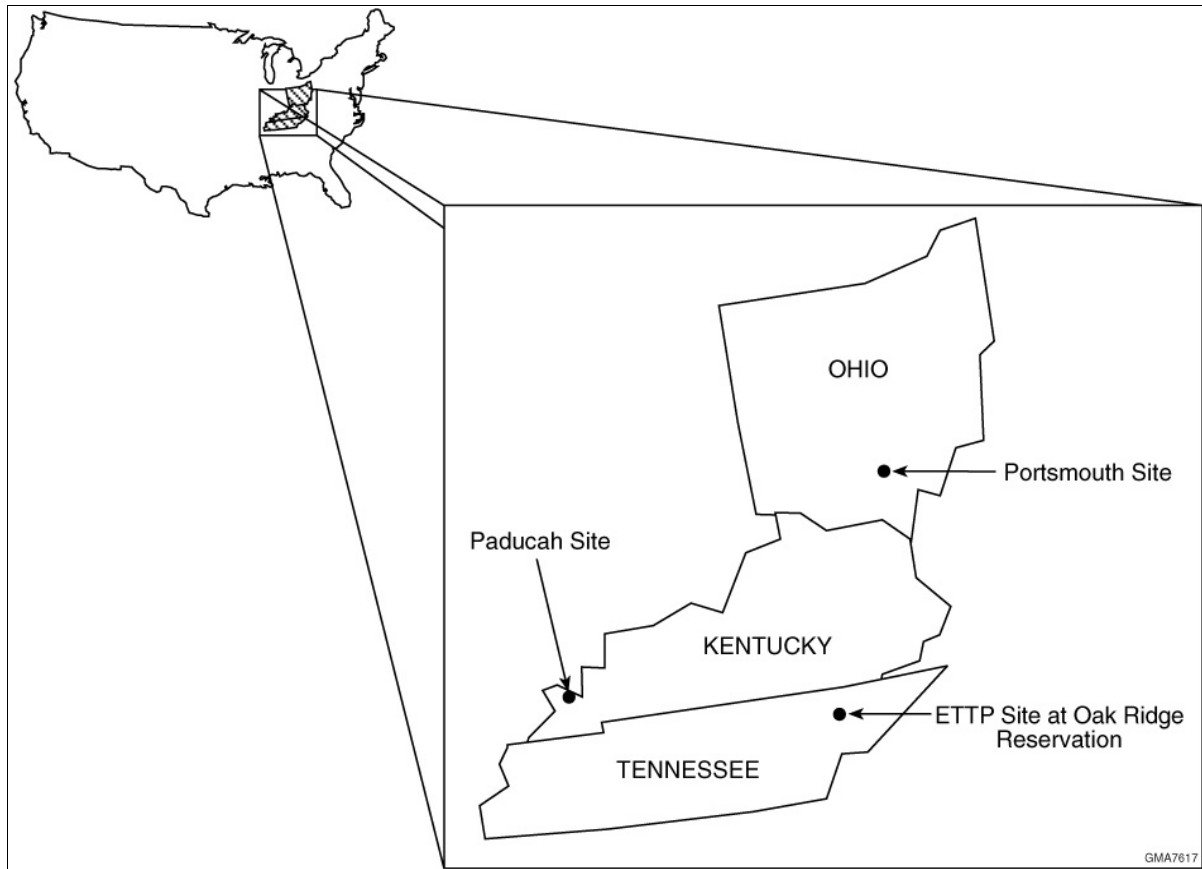
### **National Environmental Policy Act (NEPA) Regulations**

For major federal actions with the potential for significant environmental impacts, NEPA regulations require federal agencies to discuss a proposed action and all reasonable alternatives in an environmental impact statement (EIS). The information in the EIS must be sufficient for reviewers to evaluate the relative merits of each alternative.

The agency must briefly discuss any alternatives that were eliminated from further analysis. The agency should identify its preferred alternatives, if one or more exist, in the draft EIS and must identify its preferred alternative in the final EIS unless another law prohibits naming a preference. After completing the final EIS and in order to implement an alternative, the federal agency must issue a Record of Decision that announces the decision that was made and identifies the alternatives that were considered.

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<sup>1</sup> In general, in this environmental impact statement (EIS), values in English units are presented first, followed by metric units in parentheses. However, when values are routinely reported in metric units, the metric units are presented first, followed by English units in parentheses.



**FIGURE 1-1 DUF<sub>6</sub> Storage Locations**

shipping the ETTP cylinders to Paducah rather than to Portsmouth is also considered. In addition, this EIS evaluates a no action alternative, which assumes continued storage of DUF<sub>6</sub> in cylinders at the Paducah site.

## 1.1 BACKGROUND INFORMATION

The current DUF<sub>6</sub> conversion facility project is the culmination of a long history of DUF<sub>6</sub> management activities and events. To put the current project into context and provide perspective, this section provides a brief summary of this history. Additional background information on the storage and characteristics of DUF<sub>6</sub> and the DUF<sub>6</sub> cylinder inventory is provided in Section 1.2.

Uranium enrichment in the United States began as part of the atomic bomb development by the Manhattan Project during World War II. Enrichment for both civilian and military uses continued after the war under the auspices of the U.S. Atomic Energy Commission (AEC) and its successor agencies, including DOE. Three large gaseous diffusion plants (GDPs) were constructed to produce enriched uranium, first at the K-25 site (now called ETTP) and subsequently at Paducah and Portsmouth. The K-25 plant ceased operations in 1985, and the

Portsmouth plant ceased operations in 2001. The Paducah GDP continues to operate (see Section 1.1.1).

The DUF<sub>6</sub> produced during enrichment has been stored in large steel cylinders at all three gaseous diffusion plant sites since the 1950s. The cylinders are typically stacked two high and are stored outdoors on concrete or gravel yards. Figure 1.1-1 shows typical arrangements for storing cylinders.

### 1.1.1 Creation of USEC

In 1993, the U.S. government began the process of privatizing uranium enrichment services by creating the United States Enrichment Corporation (USEC), a wholly owned government corporation, pursuant to the *Energy Policy Act of 1992* (Public Law [P.L.] 102-186). The Paducah and Portsmouth GDPs were leased to USEC, but DOE retained responsibility for storage, maintenance, and disposition of about 46,422 DUF<sub>6</sub> cylinders produced before 1993 and located at the three gaseous diffusion plant sites (28,351 at Paducah, 13,388 at Portsmouth, and 4,683 at K-25). In 1996, the *USEC Privatization Act* (P.L. 104-134) transferred ownership of USEC from the government to private investors. This act provided for the allocation of USEC's liabilities between the U.S. government (including DOE) and the new private corporation, including liabilities for DUF<sub>6</sub> cylinders generated by USEC before privatization.

In May and June of 1998, USEC and DOE signed two memoranda of agreement (MOAs) regarding the allocation of responsibilities for depleted uranium generated by USEC after 1993 (DOE and USEC 1998a,b). The two MOAs transferred ownership of a total of 11,400 DUF<sub>6</sub> cylinders from USEC to DOE.

<b>DUF<sub>6</sub> Management Time Line</b>	
1950–1993	DOE generates DUF <sub>6</sub> stored in cylinders at the ETTP, Portsmouth, and Paducah sites.
1985	K-25 (ETTP) GDP ceases operations.
1992	Ohio EPA issues Notice of Violation (NOV) to Portsmouth.
1993	USEC is created by P.L. 102-186.
1994	DOE initiates DUF <sub>6</sub> PEIS.
1995	DNFSB issues Recommendation 95-1, Safety of Cylinders Containing Depleted Uranium. DOE initiates UF <sub>6</sub> Cylinder Project Management Plan.
1996	USEC Privatization Act (P.L. 104-134) is enacted.
1997	DOE issues Draft DUF <sub>6</sub> PEIS.
1998	DOE and Ohio EPA reach agreement on NOV. Two DOE-USEC MOAs transfer 11,400 DUF <sub>6</sub> cylinders to DOE. P.L. 105-204 is enacted.
1999	DOE and TDEC enter consent order. DOE issues Final DUF <sub>6</sub> PEIS. DOE issues conversion plan in response to P.L. 105-204. DNFSB closes Recommendation 95-1. DOE issues Draft RFP for conversion services.
2000	DOE issues Final RFP for conversion services.
2001	DOE receives five proposals in response to RFP. DOE identifies three proposals in competitive range. DOE publishes NOI for site-specific DUF <sub>6</sub> Conversion EIS. DOE prepares environmental critique to support conversion services procurement process. Portsmouth GDP ceases operations. DOE holds public scoping meetings for the site-specific DUF <sub>6</sub> Conversion EIS.
2002	DOE-USEC agreement transfers 23,000 t (25,684 tons) of DUF <sub>6</sub> to DOE. P.L. 107-206 is enacted. DOE awards conversion services contract to UDS. DOE prepares environmental synopsis to support conversion services procurement process.
2003	DOE announces Notice of Change in NEPA Compliance Approach and issues the draft EIS.



**FIGURE 1.1-1 Storage of DUF<sub>6</sub> Cylinders: (a) Typical 14-ton (12-t) skirted cylinder. (b) New cylinder storage yard at the Paducah site. (c, d, e) Cylinders stacked two high on concrete chocks. (f) Cylinder yards at the Paducah site.**

On June 17, 2002, DOE and USEC signed a third agreement (DOE and USEC 2002) to transfer up to 23,300 t (25,684 tons) of DUF<sub>6</sub> from USEC to DOE between 2002 and 2006. The exact number of cylinders was not specified. Transfer of ownership of all the material will take place at Paducah.

### 1.1.2 Growing Concern over the DUF<sub>6</sub> Inventory

In May 1995, the Defense Nuclear Facilities Safety Board (DNFSB), an independent DOE oversight organization within the Executive Branch, issued Recommendation 95-1 regarding storage of the DUF<sub>6</sub> cylinders. This document advised that DOE should take three actions: (1) start an early program to renew the protective coating on cylinders containing DUF<sub>6</sub> from the historical production of enriched uranium, (2) explore the possibility of additional

measures to protect the cylinders from the damaging effects of exposure to the elements as well as any additional handling that might be called for, and (3) institute a study to determine whether a more suitable chemical form should be selected for long-term storage of depleted uranium.

In response to Recommendation 95-1, DOE began an aggressive effort to better manage its DUF<sub>6</sub> cylinders, known as the *UF<sub>6</sub> Cylinder Project Management Plan* (Lockheed Martin Energy Systems, Inc. [LMES 1997d]). This plan incorporated more rigorous and more frequent inspections, a multiyear schedule for painting and refurbishing cylinders, and construction of concrete-pad cylinder yards. In December 1999, the DNFSB determined that DOE's implementation of the *UF<sub>6</sub> Cylinder Project Management Plan* was successful, and, as a result, on December 16, 1999, it closed Recommendation 95-1.

Several affected states also expressed concern over the DOE DUF<sub>6</sub> inventory. In October 1992, the Ohio Environmental Protection Agency (OEPA) issued a Notice of Violation (NOV) alleging that DUF<sub>6</sub> stored at the Portsmouth facility is subject to regulation under state hazardous waste laws applicable to the Portsmouth GDP. The NOV stated that the OEPA had determined DUF<sub>6</sub> to be a solid waste and that DOE had violated Ohio laws and regulations by not evaluating whether such waste was hazardous. DOE disagreed with this assessment and entered into discussions with the OEPA that continued through February 1998, when an agreement was reached. Ultimately, in February 1998, DOE and the OEPA agreed to set aside the issue of whether the DUF<sub>6</sub> is subject to Resource Conservation and Recovery Act (RCRA) regulation and instituted a negotiated management plan governing the storage of the Portsmouth DUF<sub>6</sub>. The agreement also requires DOE to continue its efforts to evaluate the potential use or reuse of the material. The agreement expires in 2008.

Similarly, in February 1999, DOE and the Tennessee Department of Environment and Conservation (TDEC) entered into a consent order that included a requirement for the performance of two environmentally beneficial projects: the implementation of a negotiated management plan governing the storage of the small inventory (relative to other sites) of all UF<sub>6</sub> (depleted, low-enriched [LEU-UF<sub>6</sub>], and natural) cylinders stored at the ETTP site and the removal of the DUF<sub>6</sub> from the ETTP site or the conversion of the material by December 31, 2009.

### **1.1.3 Programmatic NEPA Review and Congressional Interest**

In 1994, DOE began work on a *Programmatic Environmental Impact Statement for Alternative Strategies for the Long-Term Management and Use of Depleted Uranium Hexafluoride* (DUF<sub>6</sub> PEIS) (DOE 1999a) to evaluate potential broad management options for DOE's DUF<sub>6</sub> inventory. Alternatives considered included continued storage of DUF<sub>6</sub> in cylinders at the gaseous diffusion plant sites or at a consolidated site, and the use of technologies for converting the DUF<sub>6</sub> to a more stable chemical form for long-term storage, use, or disposal. DOE issued the draft DUF<sub>6</sub> PEIS for public review and comment in December 1997 and held hearings near each of the three sites where DUF<sub>6</sub> is currently stored (Paducah, Kentucky; Oak Ridge, Tennessee; and Portsmouth, Ohio) and in Washington, D.C. In response to its efforts, DOE received some 600 comments.

In July 1998, while the PEIS was being prepared, the President signed into law P.L. 105-204. The text of P.L. 105-204 pertinent to the management of DUF<sub>6</sub> is as follows:

*(a) PLAN. – The Secretary of Energy shall prepare, and the President shall include in the budget request for fiscal year 2000, a Plan and proposed legislation to ensure that all amounts accrued on the books of the United States Enrichment Corporation for the disposition of depleted uranium hexafluoride will be used to commence construction of, not later than January 31, 2004, and to operate, an onsite facility at each of the gaseous diffusion plants at Paducah, Kentucky, and Portsmouth, Ohio, to treat and recycle depleted uranium hexafluoride consistent with the National Environmental Policy Act.*

DOE began, therefore, to prepare a responsive plan while it proceeded with the PEIS.

In April 1999, DOE issued the final DUF<sub>6</sub> PEIS. The PEIS identified conversion of DUF<sub>6</sub> to another chemical form for use or long-term storage as part of the preferred management alternative. In the Record of Decision (ROD; *Federal Register*, Volume 64, page 43358 [64 FR 43358]), DOE decided to promptly convert the DUF<sub>6</sub> inventory to a more stable uranium oxide form (DOE 1999b). DOE also stated that it would use the depleted uranium oxide as much as possible and store the remaining depleted uranium oxide for potential future uses or disposal, as necessary. In addition, DUF<sub>6</sub> would be converted to depleted uranium metal only if uses for metal were available. DOE did not select a specific site or sites for the conversion facilities but reserved that decision for subsequent NEPA review. (This EIS is that site-specific review.)

Then, in July 1999, DOE issued the *Final Plan for the Conversion of Depleted Uranium Hexafluoride as Required by Public Law 105-204* (DOE 1999c). The Conversion Plan describes the steps that would allow DOE to convert the DUF<sub>6</sub> inventory to a more stable chemical form. It incorporates information received from the private sector in response to a DOE request for expressions of interest; ideas from members of the affected communities, Congress, and other interested stakeholders; and the results of the analyses for the final DUF<sub>6</sub> PEIS. The Conversion Plan describes DOE's intent to chemically process the DUF<sub>6</sub> to create products that would present a lower long-term storage hazard and provide a material suitable for use or disposal.

#### **1.1.4 DOE Request for Contractor Proposals and Site-Specific NEPA Review**

DOE initiated the Conversion Plan on July 30, 1999, by announcing the availability of a draft Request for Proposals (RFP) for a contractor to design, construct, and operate DUF<sub>6</sub> conversion facilities at the Paducah and Portsmouth sites.

In early 2000, on the basis of comments received on the draft RFP, DOE revisited some of the assumptions about managing the DUF<sub>6</sub> inventory that had been made previously in the PEIS and ROD. For example, DOE evaluated four potential conversion forms — depleted triuranium octaoxide (U<sub>3</sub>O<sub>8</sub>), depleted uranium dioxide (UO<sub>2</sub>), depleted uranium tetrafluoride (UF<sub>4</sub>), and depleted uranium metal — and found that they should be acceptable for near-surface

disposal at low-level radioactive waste (LLW) disposal sites located in arid climates, such as those at DOE's Nevada Test Site (NTS) and Envirocare of Utah, Inc. Therefore, the RFP was modified to allow for a wider range of potential conversion product forms and process technologies than had been reviewed in the DUF<sub>6</sub> PEIS. DOE stated that, if the selected conversion technology would generate one of the previously unconsidered products (e.g., depleted uranium metal or depleted UF<sub>4</sub>), DOE would review the potential environmental impacts as part of the site-specific NEPA review.

On October 31, 2000, DOE issued a final RFP to procure a contractor to design, construct, and operate DUF<sub>6</sub> conversion facilities at the Paducah and Portsmouth sites. The RFP stated that any conversion facilities that would be built would have to convert the DUF<sub>6</sub> within a 25-year period to a more stable chemical form that would be suitable for either beneficial use or disposal. The selected contractor would use its proposed technology to design, construct, and operate the conversion facilities for an initial 5-year period. Operation would include (1) maintaining the DUF<sub>6</sub> inventories and conversion product inventories; (2) transporting all UF<sub>6</sub> storage cylinders currently located at ETTP to a conversion facility at the Portsmouth site, as appropriate; and (3) transporting to an appropriate disposal site any conversion product for which no use was found. The selected contractor would also be responsible for preparing such excess material for disposal.

In March 2001, DOE announced the receipt of five proposals in response to the RFP, and in August 2001, DOE deemed three of these proposals to be within the competitive range.

On September 18, 2001, DOE published a Notice of Intent (NOI) in the *Federal Register* (66 FR 48123) announcing its intention to prepare an EIS for the proposed action to construct, operate, maintain, and decontaminate and decommission two DUF<sub>6</sub> conversion facilities at Portsmouth, Ohio, and Paducah, Kentucky. DOE held three scoping meetings to provide the public with an opportunity to present comments on the scope of the EIS and to ask questions and discuss concerns with DOE officials regarding the EIS. The scoping meetings were held in Piketon, Ohio, on November 28, 2001; in Oak Ridge, Tennessee, on December 4, 2001; and in Paducah, Kentucky, on December 6, 2001.

The alternatives identified in the NOI included a two-plant alternative (one at the Paducah site and another at the Portsmouth site), a one-plant alternative (only one plant would be built, at either the Paducah or the Portsmouth site), an alternative using existing UF<sub>6</sub> conversion capacity at commercial nuclear fuel fabrication facilities, and a no action alternative. For alternatives that involved constructing one or two new plants, DOE planned to consider alternative conversion technologies, local siting alternatives within the Paducah and Portsmouth site boundaries, and the shipment of DUF<sub>6</sub> cylinders stored at ETTP to either the Portsmouth site or to the Paducah site. The technologies to be considered in the EIS were those submitted in response to the October 2000 RFP, plus any other technologies that DOE believed must be considered.

### 1.1.5 Public Law 107-206 Passed by Congress

During the site-specific NEPA review process, Congress acted again regarding DUF<sub>6</sub> management, and on August 2, 2002, the President signed the *2002 Supplemental Appropriations Act for Further Recovery from and Response to Terrorist Attacks on the United States* (P.L. 107-206). The pertinent part of P.L. 107-206 required that, within 30 days of enactment, DOE must award a contract for the scope of work described in the October 2000 RFP, including design, construction, and operation of a DUF<sub>6</sub> conversion facility at each of the Department's Paducah, Kentucky, and Portsmouth, Ohio, sites. The relevant portions of the Appropriations Act are set forth in Appendix A.

In response to P.L. 107-206, on August 29, 2002, DOE awarded a contract to Uranium Disposition Services, LLC (hereafter referred to as UDS) for construction and operation of two conversion facilities. DOE also reevaluated the appropriate scope of its site-specific NEPA review and decided to prepare two separate EISs, one for the plant proposed for the Paducah site and a second for the Portsmouth site. This change was announced in the *Federal Register* Notice of Change in NEPA Compliance Approach on April 28, 2003 (68 FR 22368).

## 1.2 CHARACTERISTICS OF DUF<sub>6</sub>

DUF<sub>6</sub> results from the process of making uranium suitable for use as fuel in nuclear reactors or for military applications. The use of uranium in these applications requires that the proportion of the uranium-235 isotope found in natural uranium, which is approximately 0.7% by weight (wt%), be increased through an isotopic separation process. To achieve this increase, a uranium-235 enrichment process called gaseous diffusion is used in the United States. The gaseous diffusion process uses uranium in the form of UF<sub>6</sub>, primarily because UF<sub>6</sub> can conveniently be used in gaseous form for processing, in liquid form for filling or emptying containers, and in solid form for storage. Solid UF<sub>6</sub> is a white, dense, crystalline material that resembles rock salt.

Depleted uranium is uranium that, through the enrichment process, has been stripped of a portion of the uranium-235 that it once contained so that its proportion is lower than the 0.7 wt% found in nature. The uranium in most of DOE's DUF<sub>6</sub> has between 0.2 wt% and 0.4 wt% uranium-235.

The chemical and physical characteristics of DUF<sub>6</sub> pose potential health risks, and the material is handled accordingly. Uranium and its decay products in DUF<sub>6</sub> emit low levels of alpha, beta, gamma, and neutron radiation. The radiation levels measured on the outside surface of filled DUF<sub>6</sub> storage cylinders are typically about 2 to 3 millirem per hour (mrem/h), decreasing to about 1 mrem/h at a distance of 1 ft (0.3 m). If DUF<sub>6</sub> is released to the atmosphere, it reacts with water vapor in the air to form HF and a uranium oxyfluoride compound called uranyl fluoride (UO<sub>2</sub>F<sub>2</sub>). These products are chemically toxic to humans. Uranium is a heavy metal that, in addition to being radioactive, can have toxic chemical effects (primarily on the kidneys) if it enters the bloodstream by means of ingestion or inhalation. HF is an extremely



corrosive gas that can damage the lungs and cause death if inhaled at high enough concentrations. In light of such characteristics, DOE stores DUF<sub>6</sub> in a manner designed to minimize the risk to workers, the public, and the environment.

DUF<sub>6</sub> has been stored in large steel cylinders at all three storage sites since the 1950s. Several different cylinder types are in use, although the vast majority of cylinders have a 14-ton (12-t) capacity. (Typical cylinders in storage are shown in Figure 1.1-1.) The cylinders with a 14-ton (12-t) capacity are 12 ft (3.7 m) long by 4 ft (1.2 m) in diameter; most have a steel wall that is 5/16 in. (0.79 cm) thick. The cylinders have external stiffening rings that provide support. Lifting lugs for handling are attached to the stiffening rings. A small percentage of the cylinders have skirted ends (extensions of the cylinder walls past the rounded ends of the cylinder), as shown in Figure 1.1-1. Each cylinder has a single valve for filling and emptying located on one end at the 12 o'clock position. Similar but slightly smaller cylinders with a capacity of 10 tons (9 t) are also in use. Most of the cylinders were manufactured in accordance with an American National Standards Institute standard (ANSI N14.1, *American National Standard for Nuclear Materials — Uranium Hexafluoride — Packaging for Transport*) as specified in 49 CFR 173.420, the federal regulations governing transport of DUF<sub>6</sub>.

### 1.2.1 Cylinder Inventory

This EIS considers conversion of the DUF<sub>6</sub> inventory stored at the Paducah site for which DOE has responsibility. Statistics on the DUF<sub>6</sub> cylinders managed by DOE at the Paducah site as of April 30, 2003, are summarized in Table 1.1-1. Approximately

#### Cylinder-Related Terms Used in This EIS

##### Types of UF<sub>6</sub>

UF <sub>6</sub>	A chemical composed of one atom of uranium combined with six atoms of fluorine. UF <sub>6</sub> is a volatile white crystalline solid at ambient conditions.
Normal UF <sub>6</sub>	UF <sub>6</sub> made with uranium that contains the isotope uranium-235 at a concentration equal to that found in nature, that is, 0.7% uranium-235.
DUF <sub>6</sub>	UF <sub>6</sub> made with uranium that contains the isotope uranium-235 in concentrations less than the 0.7% found in nature. In general, the DOE DUF <sub>6</sub> contains between 0.2% and 0.4% uranium-235.
LEU-UF <sub>6</sub>	UF <sub>6</sub> made with uranium containing more than 0.7% but less than 20% uranium-235 (low-enriched uranium). In general, DOE LEU-UF <sub>6</sub> considered in this EIS contains less than 5% uranium-235.
Reprocessed UF <sub>6</sub>	UF <sub>6</sub> made with uranium that was previously irradiated in a nuclear reactor and chemically separated during reprocessing.

##### Types of Cylinders

Full DUF <sub>6</sub>	Cylinders filled to 62% of their volume with DUF <sub>6</sub> (some cylinders are slightly overfilled).
Partially Full	Cylinders that contain more than 50 lb (23 kg) of DUF <sub>6</sub> but less than 62% of their volume.
Heel	Cylinders that contain less than 50 lb (23 kg) of residual nonvolatile material left after the DUF <sub>6</sub> has been removed.
Empty	Cylinders that have had the DUF <sub>6</sub> and heel material removed and contain essentially no residual material.
Feed	Cylinders used to supply UF <sub>6</sub> into the enrichment process. Most feed cylinders contain natural UF <sub>6</sub> , although some historically contained reprocessed UF <sub>6</sub> .
Non-DUF <sub>6</sub>	A term used in this EIS to refer to cylinders that contain LEU-UF <sub>6</sub> , normal UF <sub>6</sub> , or are empty.

**TABLE 1.1-1 Inventory of DOE UF<sub>6</sub> Cylinders Considered in This EIS<sup>a</sup>**

Location	No. of Cylinders	Weight of UF <sub>6</sub> (t)
Paducah – DUF <sub>6</sub>	36,191	436,400
Non-DUF <sub>6</sub>		
LEU-UF <sub>6</sub>	182	1,600
Normal UF <sub>6</sub>	1,485	16,000
Empty	275	0
ETTP <sup>b</sup> – DUF <sub>6</sub>	4,817	54,300
Non-DUF <sub>6</sub>		
LEU-UF <sub>6</sub>	738	6
Normal UF <sub>6</sub>	225	19
Empty	584	0
Total		
DUF <sub>6</sub>	41,008	490,700
Non-DUF <sub>6</sub>	3,489	17,625

<sup>a</sup> As of April 30, 2003 (Hartman 2003).

<sup>b</sup> The proposed action calls for shipment of the ETTP cylinders to Portsmouth.

36,200 cylinders containing almost 440,000 t (484,000 tons) of DUF<sub>6</sub> are managed at Paducah. In addition to the DUF<sub>6</sub> cylinders, included in the Paducah inventory are approximately 1,940 DOE cylinders that contain low-enriched UF<sub>6</sub> (LEU-UF<sub>6</sub>), normal UF<sub>6</sub>, or are empty (collectively called “non-DUF<sub>6</sub>” cylinders in this EIS). The management of these non-DUF<sub>6</sub> cylinders is included in the EIS; however, their ultimate disposition is outside the scope of the EIS.

The conversion facility proposed for Paducah is designed to convert 18,000 t (20,000 tons) of DUF<sub>6</sub> per year (approximately 1,400 cylinders per year). At that rate of throughput, it will take approximately 25 years to convert the Paducah cylinder inventory.

The cylinder inventory at the ETTP site is also listed in Table 1.1-1. Approximately 4,800 DUF<sub>6</sub> and 1,600 non-DUF<sub>6</sub> cylinders are stored at ETTP. The non-DUF<sub>6</sub> cylinders contain a total of approximately 25 t (28 tons) of UF<sub>6</sub> (6 t [7 tons] of LEU-UF<sub>6</sub> plus 19 t [21 tons] of normal UF<sub>6</sub>) (Hartman 2003). In general, the LEU-UF<sub>6</sub> in cylinders at Paducah and ETTP contains less than 5% uranium-235.

In addition to the Paducah and ETTP inventories, approximately 16,000 cylinders are managed at the Portsmouth site. Construction and operation of a conversion facility at the Portsmouth site for conversion of the Portsmouth and ETTP inventories is the subject of a separate EIS (DOE 2003a).

DOE proposes to ship all ETTP cylinders to Portsmouth. However, this EIS does consider an option of shipping the ETTP cylinders to Paducah. If the ETTP cylinders were shipped to Paducah, the Paducah conversion facility would operate for approximately 28 rather than 25 years to convert the DUF<sub>6</sub> cylinders. The shipment of the non-DUF<sub>6</sub> cylinders to Paducah is also included. It is assumed that the normal UF<sub>6</sub> and LEU-UF<sub>6</sub> cylinders from both Paducah and ETTP would be put to beneficial uses; therefore, conversion of the contents of the non-DUF<sub>6</sub> cylinders is not considered.

The evaluation of the no action alternative in this EIS is based on the assessment conducted for the PEIS, which was revised to reflect updated information. To account for uncertainties related to the amount of USEC-generated DUF<sub>6</sub> to be managed in the future, the PEIS analysis used for this EIS assumed that a total of approximately 40,400 DUF<sub>6</sub> cylinders at the Paducah site would need to be managed.

Several reasonably foreseeable activities could potentially result in a future increase in the number of DUF<sub>6</sub> cylinders for which DOE has management responsibility. These include potential transfers of DUF<sub>6</sub> to DOE from continued USEC gaseous diffusion plant operations at Paducah; from a future USEC advanced enrichment technology plant at Portsmouth, Paducah, or elsewhere; and from some unspecified future commercial uranium enrichment facility licensed and operated in the United States. Such an inventory increase could result in a future decision to extend conversion facility operations at one or both of the conversion facility sites. These issues are discussed in more detail in Section 2.2.5 and are included in the assessment of impacts presented in Chapter 5.

### **1.2.2 Cylinder Condition and Potential Transuranic Contamination**

As the inventory of DUF<sub>6</sub> cylinders ages, some cylinders have begun to show evidence of external corrosion. As of August 2002, at all three storage sites combined, 11 cylinders had developed holes (breaches). The majority of these breaches were the result of handling damage during stacking or handling damage followed by corrosion. Only 2 of the 11 breaches are believed to have resulted from corrosion alone. At Paducah, a total of 3 cylinder breaches have occurred. However, since DUF<sub>6</sub> is solid at ambient temperatures and pressures, it is not readily released after a cylinder leak or breach. When a cylinder is breached, moist air reacts with the exposed solid DUF<sub>6</sub> and iron, forming a dense plug of solid uranium and iron compounds and a small amount of HF gas. The plug limits the amount of material released from a breached cylinder. When a cylinder breach is identified, the cylinder is typically repaired or its contents are transferred to a new cylinder.

Because reprocessed uranium was enriched in the early years of gaseous diffusion, some of the DUF<sub>6</sub> inventory is contaminated with small amounts of technetium (Tc) and the transuranic (TRU) elements plutonium (Pu), neptunium (Np), and americium (Am). In 2000, DOE, on the basis of existing process knowledge and results from additional sampling of cylinders, characterized the TRU and Tc contamination in the DUF<sub>6</sub> cylinders. As indicated in a report by Oak Ridge National Laboratory (ORNL) (Hightower et al. 2000), nondetectable or very low levels of TRU elements were found to be dispersed in the DUF<sub>6</sub> stored in the cylinders.

However, higher levels of TRU elements, associated with the “heels” remaining in a small number of cylinders formerly used to store reprocessed uranium, are expected to occur. (The term “heel” refers to the residual amount of nonvolatile material left in a cylinder following removal of the DUF<sub>6</sub>, typically less than 50 lb [23 kg].) The final RFP for providing conversion services concluded that any DUF<sub>6</sub> contaminated with TRU elements and Tc at the concentrations expected to be encountered could be safely handled in a conversion facility. The data and assumptions used in this EIS to evaluate potential impacts from the DUF<sub>6</sub> contaminated with Tc and TRU elements are described in Appendix B.

### 1.3 PURPOSE AND NEED

DOE needs to convert its inventory of DUF<sub>6</sub> to a more stable chemical form for use or disposal. This need follows directly from (1) the decision presented in the August 1999 ROD for the PEIS, namely, to begin conversion of the DUF<sub>6</sub> inventory as soon as possible, and (2) P.L. 107-206, which directs DOE to award a contract for construction and operation of conversion facilities at both the Paducah site and the Portsmouth site and to begin construction no later than July 31, 2004.

### 1.4 PROPOSED ACTION

The proposed action evaluated in this EIS is to construct and operate a conversion facility at the Paducah site for converting the Paducah DUF<sub>6</sub> inventory. The time period considered is a construction period of approximately 2 years, an operational period of 25 years, and a 3-year period for D&D of the facility.

This EIS assesses the potential environmental impacts from the following proposed activities:

- Construction, operation, maintenance, and D&D of the proposed DUF<sub>6</sub> conversion facility at the Paducah site;
- Transportation of uranium conversion products and waste materials to a disposal facility;
- Transportation and sale of the HF produced as a co-product of conversion; and
- Neutralization of HF to CaF<sub>2</sub> and its sale or disposal in the event that the HF product is not sold.

Three alternative locations for the conversion facility within the Paducah site are considered. Although not part of the proposed action, this EIS considers an option of transporting the ETTP DUF<sub>6</sub> and non-DUF<sub>6</sub> cylinders to Paducah. In addition, this EIS includes an evaluation of the impacts that would result from a no action alternative (i.e., continued DUF<sub>6</sub> cylinder storage at the Paducah site).

## 1.5 DOE DUF<sub>6</sub> MANAGEMENT PROGRAM

In fiscal year (FY) 2001, the responsibility for all uranium program activities was transferred from DOE's Office of Nuclear Energy, Science, and Technology (NE) to its Office of Environmental Management (EM). All activities related to this program are managed by the Oak Ridge Office (EM-32) within DOE's Office of Site Closure (EM-30). The uranium program supports important government activities associated with the federal enrichment program that were not transferred to USEC under the provisions of the National Energy Policy Act of 1992 (P.L. 102-486), including management of highly enriched uranium; management of the facilities at the Paducah and Portsmouth sites; responsibility for preexisting liabilities; management of DOE's inventories of DUF<sub>6</sub> and other surplus uranium; and oversight of the construction of DUF<sub>6</sub> conversion facilities.

Within the uranium program is DOE's DUF<sub>6</sub> management program, whose mission is to safely and efficiently manage DOE's inventory of DUF<sub>6</sub> in a way that protects the health and safety of workers and the public and protects the environment until the DUF<sub>6</sub> is either used or disposed of. In addition to the conversion activities that are the subject of this EIS, the DUF<sub>6</sub> management program involves two other primary activities: (1) surveillance and maintenance of cylinders and (2) development of beneficial uses for depleted uranium.

Since it may take 25 years to convert the DUF<sub>6</sub> in the inventory to a more stable chemical form, DOE intends to ensure the continued surveillance and maintenance of the DUF<sub>6</sub> cylinders currently in storage. Day-to-day management includes actions designed to cost-effectively improve cylinder storage conditions, such as:

- Performing regular inspections and general maintenance of cylinders and storage yards,
- Restacking and respacing the cylinders to improve drainage and allow for more thorough inspections,
- Repainting cylinder bodies and the ends of skirted cylinders as needed to arrest corrosion, and
- Constructing new concrete cylinder storage yards and reconditioning existing yards from gravel to concrete to improve storage conditions.

DOE is committed to exploring the safe, beneficial use of depleted uranium and other materials that result from the conversion of DUF<sub>6</sub> (e.g., HF and empty carbon steel cylinders) in order to conserve more resources and increase savings over levels achieved through disposal. Accordingly, a DOE research and development (R&D) program on uses for depleted uranium has been initiated. This program is exploring the risks and benefits associated with several uses for depleted uranium, such as a radiation shielding material, a catalyst, and a semiconductor material in electronic devices. More information about DOE's R&D on depleted uranium uses is available on the *Depleted UF<sub>6</sub> Management Information Network* Web site (<http://web.ead>).

anl.gov/uranium). In addition, in the RFP for conversion services, DOE requested that the bidders investigate and propose viable uses for the conversion products.

## 1.6 SCOPE

The scope of an EIS refers to the range of actions, alternatives, and impacts it considers. An agency generally determines the scope of an EIS through a two-part process: internal scoping and public scoping. Internal scoping refers to the agency's efforts to identify potential alternatives and important issues and to determine which analyses to include in an EIS. Public scoping refers to the agency's request for public comments on the proposed action and on the results from its internal scoping. It involves consultations with federal, state, and local agencies as well as requests for comments from stakeholder organizations and members of the general public. The EIS scoping process provides a means for the public to provide input into the decision-making process. DOE is committed to ensuring that the public has ample opportunity to participate in the review. This section summarizes the public scoping conducted for this EIS and discusses the range of issues and alternatives that resulted from the internal and public scoping process.

### 1.6.1 Public Scoping Process for This Environmental Impact Statement

On September 18, 2001, DOE published a NOI in the *Federal Register* (66 FR 48123) announcing its intention to prepare an EIS for a proposal to construct, operate, maintain, and decontaminate and decommission DUF<sub>6</sub> conversion facilities at Portsmouth, Ohio, and/or Paducah, Kentucky. The purpose of the NOI was to encourage early public involvement in the EIS process and to solicit public comments on the proposed scope of the EIS, including the issues and alternatives it would analyze. To facilitate public comments, the NOI included a detailed discussion of the project background, a list of the preliminary alternatives and environmental impacts that DOE proposed to evaluate in the EIS, and a project schedule. The NOI announced that the scoping period for the EIS would be open until November 26, 2001. The scoping period was later extended to January 11, 2002.

During the scoping process, the public was given six ways to submit comments on the DUF<sub>6</sub> proposal to DOE:

1. Attendance at public scoping meetings held in Piketon, Ohio; Oak Ridge, Tennessee; and Paducah, Kentucky;
2. Traditional mail delivery;
3. Toll-free facsimile transmission;
4. Toll-free voice message;
5. Electronic mail; and

6. Directly through the *Depleted UF<sub>6</sub> Management Information Network* Web site on the Internet (<http://web.ead.anl.gov/uranium>).

Numerous ways to communicate about issues and submit comments were provided to encourage maximum participation. All comments, regardless of how they were submitted, received equal consideration.

A total of approximately 100 individuals attended the three scoping meetings, and 20 of these individuals provided oral comments. Individuals in attendance included federal officials, state regulators, local officials, site oversight committee members, representatives of interested companies, members of local media, and private individuals. In addition, about 20 individuals and organizations provided comments through the other means available (fax, telephone, mail, e-mail, and Web site). Some of the comments received through these other means were duplicates of comments made at the scoping meetings. During the scoping period (September 18, 2001, through January 11, 2002), the *Depleted UF<sub>6</sub> Management Information Network* Web site was used a great deal; a total of 64,366 pages were viewed (averaging 554 per day) during 9,983 user sessions (averaging 85 per day) by 4,784 unique visitors.

Approximately 140 comments were received from about 30 individuals and organizations during the scoping period. Appendix C of this EIS provides a summary of these comments. These comments were examined to finalize the proposed scope of this EIS. Comments were related primarily to five major issues: (1) DOE policy; (2) alternatives; (3) cylinder inventory, maintenance, and surveillance; (4) transportation; and (5) general environmental concerns.

Most of the comments made during the public scoping period were related to issues that DOE was already planning to discuss in this EIS. Such comments helped to clarify the need for addressing those issues. However, a few issues were raised that DOE was not able to address in this EIS. These issues and the reasons why they are not addressed are summarized below.

- One commentator stated that DOE should not consider any alternatives other than the two conversion plants alternative because Congress had mandated that two plants be built: one at Paducah and one at Portsmouth. NEPA requires that the no action alternative be one of the alternatives considered. Therefore, the no action alternative has been included in this EIS.
- A request was made to designate specific routes and perform route-specific risk analyses for transporting the ETTP cylinders. Specific routes will not be known until the selected contractor is ready to ship the cylinders from ETTP. The exact routes will be determined on the basis of the shipment mode selected (truck or rail), applicable regulations, and other factors, as appropriate. Before the shipments occur, a transportation plan that will specify the exact routes will be prepared in coordination with the appropriate state agencies. However, this EIS does present an evaluation of transportation risks for representative routes that were identified by using route prediction models for truck and rail modes.

- Requests were made to analyze the impacts associated with the use of conversion products. As described further below, no large-scale uses of the depleted uranium conversion product have been identified, and current plans assume disposal of the material. The DUF<sub>6</sub> PEIS (DOE 1999a) analyzed the generic impacts associated with the manufacture of waste containers using depleted uranium and depleted UO<sub>2</sub>. Impacts associated with actual use of any depleted uranium products will be analyzed if specific uses are identified in the future and any necessary licenses, permits, or exemptions are obtained. This EIS does evaluate impacts associated with the potential sale of fluoride-containing conversion products (i.e., HF and CaF<sub>2</sub>).

### 1.6.2 Scope of This Environmental Impact Statement

In general, the scope of this EIS as described in the NOI was not changed significantly as a result of the public scoping comments received. However, in response to the congressional mandate to build conversion plants at the Paducah and Portsmouth sites (P.L. 107-206), DOE reevaluated the appropriate scope of its NEPA review and decided to prepare two separate site-specific EISs in parallel: one EIS for the facility proposed for the Paducah site and a second EIS for the Portsmouth site. This change in approach was announced in a *Federal Register* Notice published on April 28, 2003 (DOE 2003b).

This EIS addresses the potential environmental impacts at Paducah from the construction, operation, maintenance, and D&D of the proposed conversion facility; from the transportation of depleted uranium conversion products to a disposal facility; and from the transportation, sale, or disposal of the fluoride-containing conversion products (HF or CaF<sub>2</sub>). Three alternative locations within the Paducah site are evaluated for the conversion facility. An option of shipping the ETPP cylinders to Paducah for conversion is also considered. In addition, this EIS evaluates a no action alternative, which assumes continued storage of DUF<sub>6</sub> in cylinders at the Paducah site. Additional details are provided in the sections below.

#### 1.6.2.1 Alternatives

The alternatives that are evaluated and compared in this EIS include a no action alternative and three action alternatives that focus on where to site the conversion facility within the Paducah site:

1. *No Action Alternative*. Under the no action alternative, conversion would not occur. Current cylinder management activities (handling, inspection, monitoring, and maintenance) would continue; thus, the status quo would be maintained at Paducah indefinitely, consistent with the *UF<sub>6</sub> Cylinder Project Management Plan* (LMES 1997d) and consent orders, which cover actions needed to meet safety and environmental requirements.



2. *Action Alternatives.* The proposed action considers the construction and operation of a conversion facility at the Paducah site. Three alternative locations within the site are evaluated (Locations A [preferred], B, and C, which are defined in Chapter 2). In addition, an option of transporting the ETTP cylinders to Paducah is considered.

These alternatives, as well as the alternatives that were considered but not evaluated in detail, are described more fully in Chapter 2.

### **1.6.2.2 Depleted Uranium Conversion Technologies and Products**

As noted in Section 1.1.5, DOE awarded a conversion services contract to UDS on August 29, 2002. The proposed UDS facility would convert DUF<sub>6</sub> to depleted uranium oxide (primarily U<sub>3</sub>O<sub>8</sub>), a form suitable for disposal if uses are not identified. In addition to depleted U<sub>3</sub>O<sub>8</sub>, the UDS conversion facility would produce aqueous HF, which is a product that has commercial value and could potentially be sold for industrial use. The evaluation of the proposed action in this EIS is based on the proposed UDS conversion technology and facility design, which is described in Section 2.2.

The conversion project RFP did not specify the conversion product technology or form. Three proposals submitted in response to the RFP were deemed to be in the competitive range; two of these proposals involved conversion of DUF<sub>6</sub> to U<sub>3</sub>O<sub>8</sub> and the third involved conversion to depleted UF<sub>4</sub>. Potential environmental impacts associated with these proposals were considered during the procurement process, which involved the preparation of an environmental critique and environmental synopsis that were prepared in accordance with the requirements of 10 CFR 1021.216.

The environmental critique, which contains proprietary information, focuses on environmental issues pertinent to a decision among the proposals within the competitive range and includes a discussion of the purpose of the procurement and each offer, a discussion of the salient characteristics of each offer, and a comparative evaluation of the environmental impacts of the offers. The environmental synopsis is a summary document based on the environmental critique; it does not contain proprietary information. The synopsis documents the evaluation of potential environmental impacts associated with the proposals in the competitive range and does not contain procurement-sensitive information. The environmental synopsis is presented in Appendix D.

The environmental synopsis concludes that, on the basis of the assessment of potential environmental impacts presented in the critique, no proposal was clearly environmentally preferable. Although differences in a number of impact areas were identified, none of the differences were considered to result in one proposal being preferable over the others. In addition, the potential environmental impacts associated with the proposals were found to be similar to, and generally less than, those presented in the DUF<sub>6</sub> PEIS (DOE 1999a) for representative conversion technologies.

### 1.6.2.3 Transportation Modes

This EIS considers an option of shipping the cylinders at ETTP to Paducah, although current plans call for the shipment of these cylinders to Portsmouth. For this option, this EIS considers several transportation methods for preparing the DUF<sub>6</sub> cylinders and shipping them to the conversion facility. Many of the cylinders currently stored at ETTP do not meet U.S. Department of Transportation (DOT) requirements for shipment without some type of preparation first. The DUF<sub>6</sub> PEIS (DOE 1999a) and a separate transportation impact assessment (Biwer et al. 2001) contain detailed information on cylinder conditions, regulations, and preparation methods. Two methods for preparing cylinders for shipment are considered in those documents and in this EIS: (1) use of overpacks, which are large metal containers, certified to meet DOT shipping requirements, into which cylinders could be placed, and (2) use of a cylinder transfer facility, in which the UF<sub>6</sub> contents could be transferred from noncompliant cylinders to compliant ones. This EIS also considers the transportation of conversion products to a user or disposal facility. Transportation of DUF<sub>6</sub> cylinders and conversion products by two modes, truck and train, are considered in this EIS.

### 1.6.2.4 Conversion Product Disposition

As noted, the products of the DUF<sub>6</sub> conversion process would consist of depleted U<sub>3</sub>O<sub>8</sub> and HF. DOE has been working with industrial and academic researchers for several years to identify potential uses for both products. Some potential uses for depleted uranium exist or are being developed, and DOE believes that a viable market exists for the HF generated during conversion. To take advantage of these to the extent possible, DOE requested in the RFP that the bidders for conversion services investigate and propose viable uses.

Currently, there are several uses for depleted uranium, including (1) reactor fuel in breeder reactors; (2) conventional military applications, such as tank armor and armor-piercing projectiles; (3) biological shielding, which provides protection from x-rays or gamma rays; and (4) counterweights for use in aircraft applications. One characteristic of all these applications is that the amount of depleted uranium that they require is small, and existing demand can be met by depleted uranium stocks separate from the DUF<sub>6</sub> considered in this EIS; thus, these applications do not and are not expected to have a significant effect on the inventory of depleted uranium contained in the DOE DUF<sub>6</sub> inventory.

In the RFP, DOE acknowledged that uses for much of the depleted uranium may not be found, thus requiring that it be dispositioned as LLW. Studies conducted by ORNL for DOE have shown that both NTS (a DOE facility) and Envirocare of Utah, Inc. (a commercial facility) could be acceptable disposal facilities (Croff et al. 2000a,b). In its proposal, UDS recognized that applications that could use a large fraction of the depleted U<sub>3</sub>O<sub>8</sub> conversion product are not currently available and identified the Envirocare facility as the primary and NTS as the secondary disposal site. UDS provided evidence that both sites can presently accept the material. Thus, this EIS considers the transportation of depleted U<sub>3</sub>O<sub>8</sub> to Envirocare and NTS for disposal.

This EIS evaluates the impacts from packaging, handling, and transporting depleted U<sub>3</sub>O<sub>8</sub> from the conversion facility to disposal sites that would be (1) selected in a manner consistent with DOE policies and orders and (2) authorized or licensed to receive the conversion products by DOE (in conformance with DOE orders), the U.S. Nuclear Regulatory Commission (NRC; in conformance with NRC regulations), or an NRC Agreement State agency (in conformance with state laws and regulations determined to be equivalent to NRC regulations). Assessment of the impacts and risks from on-site handling and disposal at the LLW disposal facility are deferred to the disposal site's site-specific NEPA or licensing documents.

In addition, UDS believes that aqueous HF generated during conversion is a valuable commercial commodity that could be readily sold for industrial use. Thus, this EIS evaluates impacts associated with HF sale and use. To account for the possibility that uses for HF will not be identified, this EIS also evaluates a contingency for the neutralization of HF to the unreactive solid CaF<sub>2</sub> for sale or disposal.

#### **1.6.2.5 Human Health and Environmental Issues**

This EIS evaluates and compares the potential impacts on human health and the environment at the Paducah site under the alternatives and options described above. In general, this EIS emphasizes those impacts that might differ under the various alternatives and those impacts that would be of special interest to the general public (such as potential radiation effects).

This EIS includes assessments of impacts on human health and safety, air, water, soil, biota, socioeconomics, cultural resources, site waste management capabilities, resource requirements, and environmental justice. Impacts judged by DOE to be of the greatest concern or public interest and to receive more detailed analysis include impacts on human health and safety, air and water, waste management capabilities, and socioeconomics. These issues are consequently treated in greater detail in this EIS.

The process of estimating environmental impacts from the conversion of DUF<sub>6</sub> is subject to some uncertainty because final facility designs are not yet available. In addition, the methods used to estimate impacts have uncertainties associated with their results. This EIS impact assessment was designed to ensure — through the selection of assumptions, models, and input parameters — that impacts would not be underestimated and that relative comparisons among the alternatives would be valid and meaningful. This approach was developed by uniformly applying common assumptions to each alternative and by choosing assumptions intended to produce conservative estimates of impacts — that is, assumptions that would lead to overestimates of the expected impacts. Although uncertainty may characterize estimates of the absolute magnitude of impacts, a uniform approach to impact assessment enhances the ability to make valid comparisons among alternatives. This uniform approach was implemented in the analyses conducted for this EIS to the extent practicable.

## 1.7 RELATIONSHIP TO OTHER NEPA REVIEWS

This site-specific DUF<sub>6</sub> Conversion EIS, along with the EIS prepared for the Portsmouth conversion facility (DOE/EIS-0360), represents the second level of a tiered environmental review process being used to evaluate and implement DOE's DUF<sub>6</sub> Management Program. A "tiered" process refers to a process of first addressing higher-order decisions in a PEIS and then conducting a more narrowly focused (project-level) environmental review. The project-level review incorporates, by reference, the programmatic analysis, as appropriate, as well as additional site-specific analyses. The DUF<sub>6</sub> PEIS (DOE 1999a), issued in April 1999, represents the first level of this tiered process.

DOE prepared, or is in the process of preparing, other NEPA reviews that are related to the management of DUF<sub>6</sub> or to the current DUF<sub>6</sub> storage sites. The DUF<sub>6</sub> PEIS includes an extensive list of reviews that were prepared before 1999; that list is not repeated here. The following related NEPA reviews were conducted after publication of the DUF<sub>6</sub> PEIS; these reviews are related to this EIS primarily because they evaluate activities occurring at Paducah.

- *Supplement Analysis for Transportation of DOT Compliant Depleted Uranium Hexafluoride Cylinders from the East Tennessee Technology Park to the Portsmouth Gaseous Diffusion Plant in Fiscal Years 2003 through 2005* (DOE 2003d): The purpose of this supplement analysis is to provide a basis for determining whether the existing PEIS NEPA analysis and documentation would be sufficient to allow DOE to transport up to 1,700 full cylinders containing DUF<sub>6</sub> from its ETTP location to the Portsmouth site in FYs 2003 through 2005. All of these cylinders would be compliant with DOT regulatory requirements. Details of the proposed shipment campaign are presented in a transportation plan prepared by Bechtel Jacobs Company LLC (2003). Based on the Supplement Analysis, DOE issued an amended ROD to the PEIS concluding that the estimated impacts for the proposed transport of up to 1,700 cylinders were less than or equal to those considered in the PEIS and that no further NEPA documentation was required (68 FR 53603). However, because no shipments had occurred by the time this draft EIS was issued, this EIS considers shipment of all DUF<sub>6</sub> and non-DUF<sub>6</sub> at ETTP to Portsmouth (proposed) and Paducah (option).
- *Predecisional Draft, Environmental Assessment for Waste Disposition Activities at the Paducah Site, Paducah, Kentucky* (DOE 2002b): DOE proposes disposition activities for polychlorinated biphenyl (PCB) waste, LLW, low-level radioactive mixed waste (LLMW), and TRU waste from the Paducah site. All of the wastes would be transported for disposal at various locations in the United States. This environmental assessment (EA) for the disposition of various DOE wastes stored and/or generated at nonleased portions of the Paducah site was prepared in accordance with CEQ and DOE regulations and DOE orders and guidance regarding these waste types. This EA (1) provides an evaluation of the potential effects from the disposition of accumulated legacy and ongoing operational wastes at the Paducah site;

(2) presents the most current volumes of Environmental Management Program wastes at the Paducah site; (3) is tiered under other currently existing NEPA documents; (4) is intended to supplement and update the previous NEPA evaluation of waste disposition activities; and (5) does not include a detailed consideration of impacts from treatment and disposal operations at commercial facilities.

- *Final Environmental Assessment, Proposed Demonstration of the Vortec Vitrification System for Treatment of Mixed Wastes at the Paducah Gaseous Diffusion Plant* (DOE 1999d): DOE prepared this document to evaluate the proposed construction and operation of a demonstration facility at the Paducah site in McCracken County, Kentucky. The objective of the demonstration is to evaluate the Vortec Cyclone Melting System™, a glass-making vitrification process for treating various wastes that resulted from previous operations at the Paducah site. Wastes to be treated include LLW, LLMW, Toxic Substances Control Act (TSCA)-regulated, TSCA-regulated mixed, and RCRA/TSCA-regulated mixed wastes. On the basis of the analysis in the EA, DOE determined that the demonstration would not constitute a major federal action significantly affecting the quality of the human environment within the meaning of NEPA. DOE concluded that the preparation of an EIS was not required.
- *Draft Programmatic Environmental Assessment for the U.S. Department of Energy, Oak Ridge Operations Implementation of a Comprehensive Management Program for the Storage, Transportation, and Disposition of Potentially Re-Usable Uranium Materials* (DOE 2002a): DOE proposes to implement a comprehensive management program to safely, efficiently, and effectively manage its potentially reusable low-enriched uranium, normal uranium, and depleted uranium. Uranium materials presently located at multiple sites are to be consolidated by transporting the materials to one or several locations to facilitate disposition. Management would include the storage, transport, and ultimate disposition of these materials. This programmatic EA (PEA) addresses the proposed action to implement a long-term (more than 20 years) management plan for DOE's inventory of potentially reusable low-enriched, normal, and depleted uranium.
- *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 1997): This EIS (referred to herein as the WM PEIS) evaluates the impacts of different approaches to the treatment, storage, and disposal of the existing and projected DOE inventory of certain types of waste management program wastes over the next 20 years. The WM PEIS considers radioactive low-level, high-level, TRU, and mixed wastes, as well as toxic and hazardous wastes. The amounts of wastes analyzed for treatment, storage, or disposal range from thousands to millions of cubic meters and include wastes generated at the DOE sites in Paducah, Kentucky; Portsmouth, Ohio; and

Oak Ridge, Tennessee. The WM PEIS does not evaluate management of DUF<sub>6</sub> because that material is considered a source material, not a waste. The draft WM PEIS was issued in September 1995, and the final was issued in May 1997.

The WM PEIS considers the impacts of waste management at Paducah, Portsmouth, and the Oak Ridge Reservation (ORR) on the basis of existing and projected inventories of waste generated during site operations. The three sites are also considered as candidate sites for regionalized waste management sites, and waste management impacts are evaluated for these scenarios as well. Cumulative impacts of current operations, waste management, and proposed future operations are also assessed for the three sites in the WM PEIS.

## **1.8 OTHER DOCUMENTS AND STUDIES RELATED TO DUF<sub>6</sub> MANAGEMENT AND CONVERSION ACTIVITIES**

In addition to the related NEPA reviews described in Section 1.7, other reports that relate to managing the DUF<sub>6</sub> inventory (covering conversion, transportation, characterization, and disposal activities) that were completed after the DUF<sub>6</sub> PEIS was published were also reviewed in preparing this EIS. A list of the reports reviewed and used as a part of the preparation for this EIS is provided here.

- *Final Plan for the Conversion of Depleted Uranium Hexafluoride as Required by Public Law 105-204* (DOE 1999b): This report is the final plan for converting DOE's DUF<sub>6</sub> inventory, as required by P.L. 105-204. This Conversion Plan describes the steps that would allow DOE to convert the DUF<sub>6</sub> inventory to a more stable chemical form. It incorporates information received from the private sector in response to DOE's request for expressions of interest; ideas from members of the affected communities, Congress, and other interested stakeholders; and the results of the analyses for the final DUF<sub>6</sub> PEIS. The Conversion Plan describes DOE's intent to chemically process the DUF<sub>6</sub> to create products that would present a lower long-term storage hazard and provide a material suitable for use or disposal.
- *U.S. Department of Energy DUF<sub>6</sub> Materials Use Roadmap* (DOE 2000a): This report meets the commitment presented in the Conversion Plan by providing a comprehensive roadmap that DOE will use to guide any future R&D activities for the materials associated with its DUF<sub>6</sub> inventory. It supports the decision presented in the ROD, namely, to begin conversion of the DUF<sub>6</sub> inventory to uranium oxide, uranium metal, or a combination of both as soon as possible, while allowing for future uses for as much of this inventory as possible. This roadmap is intended to explore potential uses for the DUF<sub>6</sub> conversion products and identify areas where further development is needed. Although it focuses on potential governmental uses of DUF<sub>6</sub>

conversion products, it also incorporates a limited analysis of private sector uses. This roadmap also addresses other surplus depleted uranium, primarily in the form of depleted uranium trioxide (UO<sub>3</sub>) and depleted UF<sub>4</sub>.

- *Depleted Uranium Hexafluoride Management Program: Data Compilation for the Paducah Site in Support of Site-Specific NEPA Requirements for Continued Cylinder Storage, Cylinder Preparation, Conversion, and Long-Term Storage Activities* (Hartmann 1999): This report is a compilation of site-specific data and analyses for the Paducah site that were obtained and conducted to prepare the DUF<sub>6</sub> PEIS. The report describes the affected environment at the Paducah site and summarizes potential environmental impacts that could result from conducting the following DUF<sub>6</sub> activities at the site: continued cylinder storage, preparation of cylinders for shipment, conversion, and long-term storage.
- *Evaluation of UF<sub>6</sub>-to-UO<sub>2</sub> Conversion Capability at Commercial Nuclear Fuel Fabrication Facilities* (Ranek and Monette 2001): This report examines the capabilities of existing commercial nuclear fuel fabrication facilities to convert DUF<sub>6</sub> to depleted UO<sub>2</sub>. For domestic facilities, the information summarized includes currently operating capacity to convert DUF<sub>6</sub> to UO<sub>2</sub>; transportation distances from DUF<sub>6</sub> storage locations near Oak Ridge, Portsmouth, and Paducah to the commercial conversion facilities; and regulatory requirements for nuclear fuel fabrication and transportation of DUF<sub>6</sub>. The report concludes that current U.S. commercial nuclear fuel fabricators could convert 5,200 t (5,700 tons) of DUF<sub>6</sub> per year to UO<sub>2</sub> (which includes 666 t [734 tons] of DUF<sub>6</sub> per year of capacity that was scheduled for shutdown by the end of 2001). However, only about 300 t (330 tons) of DUF<sub>6</sub> per year of this capacity could be confirmed as being possibly available to DOE. The report also provides some limited descriptions of the capabilities of foreign fuel fabrication plants to convert DUF<sub>6</sub> to UO<sub>2</sub>.
- *Assessment of Preferred Depleted Uranium Disposal Forms* (Croff et al. 2000a): This study assesses the acceptability of various potential depleted uranium conversion products for disposal at likely LLW disposal sites. The objective is to help DOE decide the preferred form for the depleted uranium conversion product and determine a path that will ensure reliable and efficient disposal. The study was conducted under the expectation that if worthwhile beneficial uses could not be found for the converted depleted uranium product, it would be sent to an appropriate site for disposal. The depleted uranium products are considered to be LLW under both DOE orders and NRC regulations. A wide range of issues associated with disposal are discussed in the report. The report concludes that, on balance, the four potential forms of depleted uranium (uranium metal, UF<sub>4</sub>, UO<sub>2</sub>, and U<sub>3</sub>O<sub>8</sub>) considered in the study should be acceptable, with proper controls, for near-surface disposal at sites such as NTS and Envirocare.

- *Evaluation of the Acceptability of Potential Depleted Uranium Hexafluoride Conversion Products at the Envirocare Disposal Site* (Croff et al. 2000b): With regard to the Envirocare site, the earlier report (Croff et al. 2000a), concluded that “current waste acceptance criteria suggest that the acceptability of depleted uranium hexafluoride conversion material for disposal at Envirocare of Utah is questionable. Further investigation is required before a definitive determination can be made.” The purpose of this report is to document the more thorough investigation suggested in the earlier report. It concludes that an amendment to the Envirocare license issued on October 5, 2000, has reduced the uncertainties associated with disposal of the depleted uranium product at Envirocare to the point that they are now comparable with uncertainties associated with the disposal of the depleted uranium product at NTS that were discussed in the earlier report.
- *Transportation Impact Assessment for Shipment of Uranium Hexafluoride (UF<sub>6</sub>) Cylinders from the East Tennessee Technology Park to the Portsmouth and Paducah Gaseous Diffusion Plants* (Biwer et al. 2001): This report presents a transportation impact assessment for shipping the 4,683 full cylinders of DUF<sub>6</sub> (containing a total of approximately 56,000 t [62,000 tons]) stored at ETTP to the Portsmouth and Paducah sites for conversion. It also considers the transport of 2,394 cylinders stored at ETTP that contain a total of 25 t (28 tons) of enriched and normal uranium or that are empty. Shipments by both truck and rail are considered, with and without cylinder overpacks. In addition, the report contains an analysis of the current and pending regulatory requirements applicable to packaging UF<sub>6</sub> for transport by truck or rail, and it evaluates regulatory options for meeting the packaging requirements.
- *Strategy for Characterizing Transuranics and Technetium Contamination in Depleted UF<sub>6</sub> Cylinders* (Hightower et al. 2000): This report summarizes the results of a study performed to develop a strategy for characterizing low levels of radioactive contaminants (Pu, Np, Am, and Tc) in DUF<sub>6</sub> cylinders at the ETTP, Portsmouth, and Paducah sites. The principal conclusion from this review and analysis is that even without additional sampling, the current body of knowledge is sufficient to give potential conversion vendors an adequate basis for designing facilities that can operate safely. The report also provides upper-bound estimates of Pu, Np, and Tc concentrations in DUF<sub>6</sub> cylinders.
- *A Peer Review of the Strategy for Characterizing Transuranics and Technetium Contamination in Depleted Uranium Hexafluoride Tails Cylinders* (Brumburgh et al. 2000): This document provides the findings from a peer review of the ORNL study (Hightower et al. 2000) that set forth a strategy for characterizing low levels of radioactive contaminants in DUF<sub>6</sub> cylinders at the ETTP, Portsmouth, and Paducah sites. This peer review evaluates the ORNL study in three main areas: TRU chemistry/radioactivity, statistical approach, and the uranium enrichment process. It provides both



general and specific observations about the general characterization strategy and its recommendations.

## **1.9 ORGANIZATION OF THIS ENVIRONMENTAL IMPACT STATEMENT**

This DUF<sub>6</sub> Conversion EIS consists of 10 chapters and 8 appendixes. Brief summaries of the main components of the EIS follow:

- Chapter 1 introduces the EIS, discussing pertinent background information, the purpose of and need for the DOE action, the scope of the assessment, related NEPA reviews, other related reports and studies, and EIS organization.
- Chapter 2 defines the alternatives and implementation variations considered in the EIS, defines alternatives considered but not analyzed in detail, and presents a summary comparison of the estimated environmental impacts.
- Chapter 3 discusses the environmental setting at the Paducah and ETTP sites.
- Chapter 4 addresses the assumptions on which this EIS and its analyses are based, defines the approaches to and methods for environmental impact assessment used in developing this EIS, and presents background information on the human health assessment.
- Chapter 5 discusses the potential environmental impacts of the alternatives. This chapter also discusses potential cumulative impacts at the Paducah site; possible mitigation of adverse impacts that are unavoidable; irreversible commitment of resources; the relationship between short-term use of the environment and long-term productivity; pollution prevention and waste minimization; and impacts from D&D activities.
- Chapter 6 identifies the major laws, regulations, and other requirements applicable to implementing the alternatives.
- Chapter 7 is an alphabetical listing of all the references cited in the EIS. All cited references are available to the public.
- Chapter 8 lists the name, education, and experience of persons who helped prepare the EIS. Also included are the subject areas for which each preparer was responsible.
- Chapter 9 presents brief definitions of the technical terminology used in the EIS.
- Chapter 10 is a subject matter index that provides the numbers of pages where important terms and concepts are discussed.

- Appendix A presents the pertinent text of P.L. 107-206, which mandates the construction of conversion facilities at the Portsmouth and Paducah sites.
- Appendix B discusses issues associated with potential TRU and Tc contamination of a portion of the DUF<sub>6</sub> inventory and describes how such contamination was addressed in this EIS.
- Appendix C summarizes the comments received during public scoping.
- Appendix D contains the environmental synopsis prepared to support the DUF<sub>6</sub> conversion procurement process.
- Appendix E discusses potential uses of HF and CaF<sub>2</sub>, the DOE-authorized release process, and impacts associated with sale and use.
- Appendix F describes the assessment methodologies used to evaluate the potential environmental impacts.
- Appendix G contains copies of consultation letters regarding the preparation of this EIS that were sent to state agencies and recognized Native American groups.
- Appendix H contains the contractor disclosure statement.